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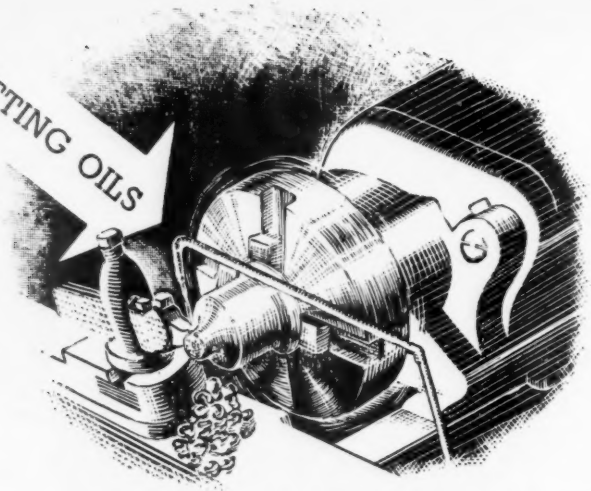

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THE HANDLING OF LEADED GASOLINE

By MARK A. PRYKE*

INTRODUCTORY

When leaded gasoline is stored and distributed in accordance with good practice, as laid down by the A.P.I. and the oil marketing organizations of the world, there is no detriment to the health of the workers handling it. Fundamentally the problems of handling leaded and unleaded gasoline are the same; however, certain basic precautions should be observed, since it is possible, under extreme conditions, for accidents to occur.

Before dealing with the particular aspects of lead in gasoline it will be opportune to touch on the characteristics of unleaded spirit.

Gasoline is a narcotic poison, with nothing especially characteristic in the symptoms it produces. Its vapours should not be inhaled if it can possibly be avoided. The presence of dangerous amounts of gasoline vapour in the atmosphere may cause dizziness, unsteadiness of gait, nausea, headaches, and even unconsciousness. Gasoline will burn the skin after sufficient contact; repeated contact will cause drying, roughness, chapping, cracking, and possibly infection or spreading irritation. Contact with the skin, and particularly with the eyes, should be avoided; if it occurs, first aid should be given promptly and the gasoline washed off with soap and hot water.

Tetraethyl lead in the form of "Ethyl"

* The Associated Ethyl Co. Ltd.

anti-knock compound is a refinery additive mixed with gasoline to raise its anti-knock value or octane number. In the pure form, tetraethyl lead is highly toxic and may be absorbed into the human system by inhalation of its vapour, by skin contact, or through the mouth, with serious and even fatal results. However, when used in motor spirit it is diluted to a maximum concentration of one part by volume in 1260, which figure has been accepted by public health authorities throughout the world as a safe limit for personnel exposed to the gasoline or its vapours.

Blending Leaded Gasoline

When handling "Ethyl" fluid, elaborate precautions must be taken to avoid contact with the liquid or the vapour, and the strictest regulations have been laid down by the manufacturers, The Associated Ethyl Co. Ltd., for the protection of chemists, blenders, and other workers. The fluid is packed for shipment in heavy gauge steel drums fitted with double bungs, and the operation of mixing it with gasoline is always done under negative pressure. A specially constructed mixing house is always provided and is equipped with a changing room and bathing facilities. The storage and mixing platforms are open on three sides for maximum ventilation. The contents of the drum are withdrawn by the suction created by passing gasoline through an eductor or venturi. The fluid is drawn into the gasoline stream in the eductor, which is placed in a by-pass of the main circulating line from the blending tank. This concentrated mixture of gasoline and fluid is then delivered to the blending tank, where it is thoroughly mixed, usually by passing it through a jet specially designed for the known conditions of operation, that is, tank diameter and height, pump capacity and pressure. For most installations this system enables complete mixing to be achieved in little more time than is necessary to add the "Ethyl" fluid.

The men employed on the blending operation are equipped with a canister type gasmask, overalls and rubber apron, rubber gloves and boots, which are worn during the whole time the drum is open. All underclothing must be changed before commencing the operation, and a shower bath taken upon completion.

In order to fit in with the refinery expansion programmes due for completion in Great Britain in the next two or three years, arrangements are now being made to supply "Ethyl" fluid in bulk, by rail tank cars. These will be discharged directly into storage tanks set on scales and the complete mixing of "Ethyl" fluid with gasoline is then carried out in a closed circuit. The only exposure of personnel to lead will be during the connexion of the tank car to the storage tank, when the usual precautions must be observed. Individual blends may then be carried out without any protective equipment, merely by opening and closing valves.

Handling Leaded Gasoline

The hazards of handling leaded gasoline should be considered in relation to the particular activity of those exposed to it, namely, oil company personnel and those engaged in engine testing and overhaul. There is no danger to any other section of the community, apart from that associated with ordinary gasoline.

Oil company personnel.—There are three distinct hazards which concern oil company personnel:

(*a*) filling small containers with leaded gasoline;
(*b*) dipping tanks and tank wagons; and
(*c*) cleaning storage tanks.

(*a*) In filling small containers with leaded gasoline, spillage, and leakage

must always be avoided by the provision of adequate filling equipment, properly installed and maintained. If droplets are sprayed into the air from nozzles, moving cans, or equipment upon which gasoline has been spilled, the cause should be determined and immediately rectified.

Filling equipment should be so located and designed as to take advantage of the maximum amount of natural ventilation. If this is not sufficient, then mechanical ventilation must be applied so as to maintain within safe limits the concentration of tetraethyl lead and gasoline vapours in the atmosphere.

This operation is controlled by regulations which are observed at all refineries and installations where leaded gasoline is handled in this manner, but there is no hazard to others who come in contact with leaded gasoline, such as service station attendants, garage mechanics, and motorists.

(*b*) Those engaged in the dipping and gauging of tanks and tank wagons, should, if possible, avoid the breathing of gasoline vapours. However, careful biological tests on such workers have not shown any significant lead absorption after prolonged periods of this work.

(*c*) The real danger to oil company personnel lies in the careless or ignorant disregard of the precautions laid down for the cleaning of tanks which have been used for the storage of leaded gasoline. During storage, small quantities of lead compounds are deposited on the bottoms of tanks; contact with the sludge in these tanks, or inhalation of vapours from this source, may result in rapid lead intoxication and even death. The cleaning of storage tanks is not a subject which can be covered in an article of this length, and a booklet of information entitled "Some notes on tank cleaning methods for tanks which have contained leaded gasoline" is available from The Associated Ethyl Co. Ltd. This booklet sets out in detail the various methods which have been found effective in cleaning tanks, and the precautions which must be observed to protect personnel. Briefly, it may be stated that no storage tank should be entered by any person for any reason unless he is wearing an airline gasmask supplied with fresh air under positive pressure. The sludge should be handled only in the wet state, and after removal from the tank should be buried in a space where it will not be subsequently disturbed.

Engine testing and overhaul.—Under this heading the hazards of contact with leaded petrol can again be subdivided into:

(*a*) the actual physical handling of the petrol;

(*b*) the washing and testing of engine parts with petrol; and

(*c*) engine exhaust fumes.

(*a*) The motor mechanic naturally comes into closer and more frequent contact with gasoline than other persons, but any danger to him will come from the gasoline itself rather than its lead content. Even after prolonged exposure to gasoline and its vapours it is these, and not the lead, which will cause illness. There is no serious danger to health from the occasional spillage of "Ethyl" petrol, even in such confined spaces as closed garages and repair shops; if there is adequate ventilation of such premises the danger from spillage is negligible.

(*b*) After operation on leaded gasoline for prolonged periods, engine parts will accumulate deposits containing lead salts. These, however, contain only negligible traces of volatile lead and, due to their coherent nature, there is little danger that lead from this source will get into the atmosphere as dust when the engine parts are being cleaned. However, it is good practice to soak these parts before brushing and scraping off the deposits. Kerosine should be used for this purpose.

Where personnel are engaged *constantly* in the testing of engine parts with leaded gasoline, certain precautions should be taken to prevent the inhalation of vapours. For example, in carburettor testing, the work-bench should be so arranged that any spillage of gasoline will drain *away* from the operator and cross-ventilation should be provided to carry away the gasoline vapours.

(*c*) There are likely to be more exhaust fumes in the atmosphere of a repair shop than would normally be found elsewhere. However, there is no significant volatile toxic lead substance in automobile exhaust fumes, the dangerous component of which is carbon monoxide. Adequate ventilation for the dispersal of carbon monoxide should be provided in all such premises.

Containers, pipelines, etc.—Gasoline containers, such as trucks, tank cars, drums, and cans, or pipelines, must not be used for the storage or transport of other than petroleum products. It is of special importance that such equipment should not be used for the subsequent storage or transport of drinking water except under extreme emergency. Gasoline pipelines must not be used for these purposes in any circumstances. Leaded gasoline containers with free rust on the interior should never be used for potable water. Tin plated or galvanized containers may be used for the carriage of drinking water, provided they have been thoroughly cleansed of lead and gasoline. The cleansing of such containers should consist of steaming or thorough washing with soap and water until all trace of gasoline odour has been removed.

In conclusion it should be stated that leaded gasoline should be used as a motor fuel only. Its use for other purposes, such as in dry cleaning, kitchen stoves, blow torches, or heating and lighting equipment involves potential danger and should be avoided.

SOUTH WALES BRANCH

On September 8, 1949, at Britannic House, Llandarcy, E. A. Evans, President of the Institute, delivered a lecture on "Additives" to members of the South Wales Branch.

In the time at his disposal it was only possible for the lecturer to deal with some of the additives used in lubricants. He traced the development from the early days when anti-oxidants and metallic soaps were first used, to the use and development of sulphur compounds as additives for extreme pressure lubricants. In a lesser degree, anti-corrosion additives and others were introduced, and in the course of the discussion which followed, Mr Evans elaborated on such points as the rapid development during the second world war, the behaviour of certain additives in different types of oils and the importance of actual engine tests for their evaluation.

The chairman, E. Thornton, mentioned that this was Mr Evans's first visit to the South Wales Branch, and thanked him for his delivery of a lecture, which covered such a large field of development in a very comprehensive manner.

The vote of thanks on behalf of the members was proposed by R. B. Southall, general manager, National Oil Refineries Ltd., and seconded by W. S. Bryan.

UNIFIED SCREW THREADS

The proceedings of the meeting at which the unification of American, British, and Canadian standard screw threads was agreed has been made available in a booklet, "Unified Screw Thread Standards" (Circular 479, U.S. Bureau of Standards). Copies are available from the U.S. Government Printing Office, Washington 25, D.C., price 30 cents (40 cents outside the U.S.A.).

SIGNIFICANCE OF PROPERTIES OF PETROLEUM PRODUCTS

V. OXIDATION AND OXIDATION STABILITY

By D. L. SAMUEL (Fellow)

ALL petroleum products under normal conditions of storage and use come into intimate contact with the atmosphere and hence with oxygen. The hydrocarbons of which petroleum principally consists react with oxygen to an extent depending on the type of hydrocarbon and the conditions under which contact is made. Thus, the paraffin or long-chain saturated compounds are in general less affected than the aromatic ring compounds while some of the unsaturated constituents are comparatively easily oxidized.

GASOLINE

Although the oxidation reaction has been studied for many years, very little is known about its mechanism, except in the case of the simpler hydrocarbons such as make up the gasoline fraction. Here, it is fairly well established, oxidation proceeds with the formation of peroxides as intermediate products.

The compounds formed by oxidation differ in their nature and composition, and include acids, gums, solid asphaltic bodies, etc., all of which may adversely affect the performance of the original product. In gasoline, oxidation is more or less confined to the period of storage. If the gasoline contains unstable constituents and storage conditions are suitable, oxidation will take place, forming products which will tend to polymerize to the well-known gasoline gum. This gum will tend to separate on standing. Such an unstable gasoline in the tank of a car may cause trouble by depositing gum in the fuel lines and petrol tank.

Some of the gum remains in solution or suspension in the spirit, and in use would cause blockage of carburettor jets and the formation of undesirable deposits in the engine, particularly on the inlet valves. Other fuels used in internal combustion engines can also be affected by oxidation, although the effects may not be so serious or so noticeable as in the case of gasoline. Thus, power kerosine used as a tractor fuel and even diesel fuels may be liable to oxidation troubles.

LUBRICANTS

Lubricants in general are stable to storage and are relatively unaffected by oxygen at ordinary temperatures. In use, however, they may be exposed to high temperatures and intimate contact with air, and under these conditions oxidation may take place. Thus, in an internal combustion engine the lubricant is sprayed and splashed around the moving parts at elevated temperatures—a state of affairs very favourable for oxidation reactions. The presence of metals may catalyze these reactions and copper, copper alloys, and even iron are particularly active in this respect. Two main types of product appear to be formed—acidic material which may corrode metal parts and solid deposits formed by polymerization of intermediate oxidized material.

Lubricating greases can also deteriorate seriously in use as a result of oxidation, and this may lead to the destruction of the grease structure and consequent failure of lubrication.

Electrical oils are used as insulating material in transformers, cables, condensers, etc., and are required to maintain their high electrical resistance for a

number of years. They are generally used in conditions where they are in contact with copper and other metals. Oxidation may lead to the formation of acidic bodies which reduce the efficiency of the oil as an insulator, and of sludge which may deposit in the windings with consequent interference with cooling.

Bitumen

Bitumen, although perhaps less affected by oxidation than the liquid hydrocarbons, can under certain circumstances be changed by exposure to air. This is particularly so when the bitumen is in the form of a thin film such as is the case with bituminous paints. The durability of road surfaces consisting of bitumen coated aggregate can be reduced from the same cause.

In all oxidation reactions certain metals can act as catalysts. Similarly the oxidation products themselves may catalyze further reactions so that the process, once started, can proceed at an ever-increasing speed.

Measurement of Oxidation Stability

The measurement of the oxidation stability of all products follows the same procedure. The material being examined is contacted with excess air or oxygen, usually at an elevated temperature, and the amount of oxygen absorbed is determined and/or the quantity of oxidation products formed is measured. Contact with excess air or oxygen is usually effected in a bomb under pressure or by bubbling the gas through the product being tested. Numbers of methods have been based on these conditions, but few have been standardized. The Institute of Petroleum "Standard Methods" at present includes oxidation tests for gasoline and lubricating oils. No such tests for fuels other than gasoline or for bitumens have been generally accepted.

In gasoline the gum stability is measured by accelerated oxidation in a steel bomb fitted with a glass liner (I.P. method 40/44 (T)); 50 ml of the sample is placed in the bomb, which is then charged with oxygen at 100 to 102 p.s.i. The whole is then placed in a boiling-water bath and the pressure in the bomb measured at intervals. The test is terminated when the break-point has been passed—break-point being defined as the point at which the pressure shows a drop of 2 p.s.i. from the maximum steady pressure. The time in minutes from the placing of the bomb in the bath to the break-point is recorded as the induction period.

The length of the induction period is a measure of the resistance of the gasoline to oxidation. During this period oxidation is proceeding extremely slowly. A point is reached, however, when the reaction commences to speed up owing, probably, to the catalytic influence of the small quantity of oxidation products already formed. Thereafter oxidation tends to become increasingly rapid.

Another test for gasoline—not strictly an oxidation test but a measure of the oxidized products present in the fuel—is the Gum (Existent) in Motor Fuel, etc. (I.P. Method 38/47 (T)). In this method a quantity of gasoline is evaporated in a glass dish placed on a vigorously boiling steam bath while a jet of air impinges on the surface of the evaporating liquid. After the gasoline has evaporated, the dish and residue are placed in an oven at 145° to 155° C for 60 minutes and then cooled and weighed. The residue will also include any non-volatile material such as dye originally present in the gasoline.

A test for determining the oxidation stability of aviation gasoline often called the "Potential Gum Method", has been adopted as a Tentative Standard by the A.S.T.M. (D873–46T). The potential gum, i.e., gum plus lead deposits formed after a specified period of oxidation, can be used as an indication of the tendency of the gasoline to form gum on storage. Oxidation is carried out at 100° C in a

bomb filled with oxygen at 100 p.s.i., and the "gum" content of the oxidized material is determined by a method very similar to that used for existent gum in motor fuel.

The oxidation bomb has been used experimentally for examing bitumen and other products. An A.S.T.M. tentative method (D942–47T) concerns the storage stability of grease and is based on the Norma-Hoffman test. The grease under examination is placed in a series of trays which fit into a bomb. This is filled with oxygen at 100 p.s.i. and placed in a bath at 100° C. To pass the test the fall in pressure in 100 hours must not exceed 5 lb.

Lubricating oils are, in general, examined for oxidation stability by the method of bubbling air or oxygen through a sample maintained at an elevated temperature.

Many varieties of this method are known, such as the Dornte, Indiana, etc., but so far only one has been standardized by the Institute—for motor oil. This is a method which appeared in a number of early Air Ministry specifications for aviation engine oils and was popularly known as the B.A.M. oxidation test. In this test (I.P. Method 48/44) 40 ml of the oil is filled into a boiling tube of specified dimensions, which is placed in an oil bath at 200° C. Air at a rate of 15 litres/hour is bubbled through the sample for 6 hours. At the end of this period the boiling tube is withdrawn from the bath and allowed to stand at room temperature for 12 to 18 hours. The sample is then replaced in the oil bath and blown with air for a further period of 6 hours, after which it is allowed to cool to atmospheric temperature.

The degree of oxidation is determined by examination of the oxidized oil in comparison with the original material. Two types of test are used—viscosity and carbon residue. The kinematic viscosities at 100° F of the oil before and after treatment are measured and the comparison expressed as a ratio:

$$\frac{\text{viscosity after oxidation}}{\text{viscosity before oxidation}}$$

Oxidation in general tends to increase the viscosity of an oil, and therefore the nearer the ratio approaches 1·0 the more resistant the oil to oxidation under these conditions. Carbon residue is carried out by the Ramsbottom method and determines the amount of residue left by an oil after evaporation at 550° C in absence of air. Oxidation of an oil yields products which can polymerize to form high molecular weight substances, and these appear as residue in this test. Thus increase in carbon residue indicates to what extent oxidation has taken place.

Another method often used to evaluate the oxidation characteristics of an oil is the Indiana oxidation test. In this test, 300 ml of the oil contained in a glass tube of specified dimensions is maintained at 341° F (171·7° C) by means of a suitably controlled oil bath. Air is blown through the sample at a rate of 10 litres/hour. At intervals samples of the oil under test are withdrawn and examined for sludge value by diluting with A.S.T.M. precipitation naphtha, filtering and weighing the precipitated sludge. A graph of sludge values against time of oxidation is drawn and the times (sludging time) until the formation of (*a*) 10 mg sludge/10 g oil; (*b*) 100 mg sludge/10 g oil are reported. Viscosity increase on oxidation can also be determined. This test has given reasonable results when applied to conventional uncompounded lubricants. However, results obtained with the modern compounded oils such as those containing inhibitors and detergents do not agree with engine-test results. For this reason a new test—the "Indiana stirring oxidation test"—was introduced.

In this method the sample is aerated without air blowing by stirring at 1300 r.p.m.; 250 ml oil in a tall 500-ml beaker is maintained at 330° F (165·5° C) and agitated with a special glass stirrer

in the presence of copper and iron catalysts. Sludge and acidity are determined at 24-hour intervals and an additional test indicates the "varnish" or "lacquer" formed by the oxidized oil. Viscosity increase can also be measured.

The Sligh oxidation test is similar in that air is not blown through the oil sample; 10 g oil are introduced into a special glass flask fitted with a ground-in stopper which can be fastened in the neck by a clamping device. The air in the flask is displaced by oxygen, the stopper clamped and the whole placed in a bath at 200° C for 2½ hours. A plug in the neck of the flask prevents circulation of the oxygen in the neck. After the oxidation period the oil is cooled and the asphaltic matter determined by diluting the oil with precipitation naphtha. The Sligh number is the number of mg of asphaltic matter per 10 g oil.

Engine Tests

A number of engine tests for lubricants have been standardized by the Co-ordinating Research Council in America, and one of these—C.R.C. L4—has been designed to determine the oxidation characteristics of heavy-duty crankcase oils. The engine—a special six-cylinder Chevrolet—is given a preliminary run-in before each test. The test procedure involves intermittent operation at constant speed and load for a total of 36 hours, samples of the crankcase oil being withdrawn at intervals.

At the conclusion of the test, engine parts are inspected and rated for varnish and sludge deposits; the copper-lead test bearings are examined for loss in weight, and a number of tests are carried out on the crankcase oil after 0, 16 and 36 hours' use. From these data the characteristics of the oil are judged.

Transformer Oils

Several methods have been devised for examining the stability of transformer oils. The I.P. method 56/46 "Sludging Value of Transformer Oils" is based on the well-known Michie test and involves the blowing of air at a rate of 2 litres/hour through the sample for 45 hours, in the presence of copper foil and at a temperature of 150° C. After oxidation the sludge or asphaltic material formed is precipitated by diluting the oil with I.P. aromatic-free petroleum spirit, filtered off and weighed. A recommendation that the acidity after oxidation should also be determined is to be adopted by the B.S.I.

The A.S.T.M. have two tentative methods (D670–42T) for determining sludge formation in transformer oils. In Method A—"Sludge accumulation test"—the oil maintained at 120° C is oxidized in the presence of a copper catalyst by passing air over the surface. The test is carried out in triplicate, the samples being oxidized for 72, 168, and 336 hours respectively. After treatment the samples are examined for sludge by precipitation with aromatic-free spirit.

Method B—"High-pressure oxidation test"—is carried out in a bomb. The oil contained in a glass vessel is placed in the bomb and oxidized for 24 hours at 140° C under 250 p.s.i. oxygen pressure. Sludge is determined on the oxidized oil by the usual precipitation method.

Turbine oils are also examined for oxidation resistance and I.P. method 114/47 (P) is similar in many respects to the I.P. method for transformer oils. However, in this case the test temperature is 110° C and the duration 90 hours. Deterioration is assessed by measuring the acidity and demulsification value of the treated oil. A.S.T.M. method D943–47T has been devised mainly to measure oxidation inhibitor life of turbine oils. The oil is oxidized at 95° C in the presence of water and an iron-copper catalyst by blowing oxygen through the sample at a rate of 3 litres/hour. Acid values of the oil are determined at intervals and a definite induction period is usually observed.

All these methods are necessarily

accelerated tests, carried out under conditions much more severe than are encountered in service. Acceleration is obtained by raising the temperature and by ensuring intimate contact between the sample and excess air or oxygen. It is, therefore, hardly to be expected that oxidation in service will always follow the same course as in the laboratory test. Thus, the degree of oxidation obtained in a few hours in the laboratory test of, e.g., transformer oil might be reached only after years of service. Again, in practice, other factors may be present which may have a profound influence on oxidation reactions. Thus, in internal combustion engines deterioration of oil by oxidation may be overshadowed by contamination with the combustion products of the fuel. The contamination may itself catalyze further oxidation; this is particularly the case when the fuel is a leaded spirit containing the usual halogen scavenger.

However, although laboratory methods may not always predict performance, they are useful for selecting the type of product which is reasonably likely to withstand the required conditions. They are also useful for comparing and rating products.

The capacity of a product for withstanding oxidation can be greatly influenced by skilful refining. Nowadays it is possible to remove constituents of a product which may be undesirable in some respects, and retain those constituents with the required properties. This is exemplified by solvent refining in the lubricating oil industry, where it is possible to make superior grades of oil from a wide range of crudes by extracting certain types of hydrocarbons. It must be noted, however, that while careful refining will produce a product with improved oxidation properties, over-refining can produce a product with poor oxidation stability. Again, refining may remove constituents which, although harmful from an oxidation standpoint, are valuable in other respects.

After balanced refining has yielded the best oxidation resistant product, further oxidation stability can be attained by the use of additives. It has been known for some time that the addition of a small amount of certain organic chemicals to petroleum products will enormously improve them in certain directions. Many different compounds have been tried as oxidation inhibitors, and most of them belong to the class of amines or phenol derivatives. In quite small amounts, usually of the order of a fraction of 1 per cent, they will delay the onset of oxidation, i.e., increase the induction period. Once the induction period is passed, however, oxidation usually proceeds at the same rate as in the absence of an inhibitor. To-day, oxidation inhibitors are used in gasolines, lubricating oils and greases, insulating oils, turbine oils, etc., and they have considerably increased the storage stability and life of these products.

Nowadays many oxidation stable products are made by a combination of optimum refining and use of additives.

Suggestions for Further Reading

1. *Standard Methods for Testing Petroleum and its Products*. Institute of Petroleum.
2. *A.S.T.M. Standards on Petroleum Products and Lubricants*. American Society for Testing Materials.
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6. Lamb, G. G., Loane, C. M., and Gaynor, J. W.: "Indiana stirring oxidation test for lubricating oils", *Industr. Engng Chem. Anal.*, 1941, **13**, 317.
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PERSONAL NOTES

A. H. Williams, M.Inst.Pet., has been appointed a director of Trinidad Consolidated Oilfields Ltd.

G. C. McEwen, M.Inst.Pet., writes from Singapore that he is now in charge of the R.A.F. petroleum laboratory which was established there at the beginning of this year. This laboratory is carrying out knock rating tests of aviation fuels by the I.C. method (I.P., 42/48 (T)), and he believes that this is the only I.C. engine operating in the Far East. Before taking up his appointment as Command Chemist, R.A.F. H.Q. in Singapore, Mr McEwen was chemist-in-charge of the petroleum laboratory at the A.I.D. Test House, Harefield.

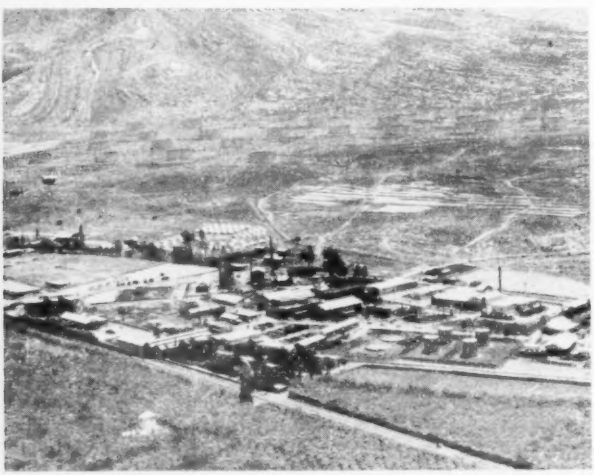
H. G. Spence, A.F.Inst.Pet., vice-chairman of the London Branch, has resigned his position as lubrication engineer with Messrs Berry Wiggins & Co. Ltd., and is now in the Technical Division of the Lubricants Department of the Shell Petroleum Co. Ltd.

IRAQ PIPELINE'S INCREASED THROUGHPUT

In July, pumping began through the Iraq Petroleum Company's new 16-in pipeline from Kirkuk to Tripoli. Next year it is expected that the new line, which runs parallel to the 12-in pipeline completed before the war, will be operating at its full capacity of 90,000 b.d.

Oil was first delivered from Kirkuk to Tripoli in July 1934, following the completion of the more northerly of two 12-in pipelines connecting the Kirkuk field with the Mediterranean seaboard. This northern line, 532 miles long, runs from Kirkuk down to the river Euphrates and thence across Syria and Lebanon to Tripoli. The 12-in southern pipeline, 620 miles long, was completed in October 1934, and runs parallel with the northern line as far as the Euphrates, then branches, running across Transjordan and Palestine to the Bay of Acre, north of Haifa. Each 12-in line has a capacity of 2,000,000 tons of crude per annum (42,500 b.d.).

The terminals at Tripoli and Haifa were originally provided with respectively 35 and 27 tanks, each of 93,000 brls capacity. At Haifa is an oil dock with four berths, each capable of loading at rates of from 600 to 700 tons per hour, and four 12-in sea lines; at Tripoli three 12-in sea lines run to each of three berths situated some 4000 ft from the shore. Since the completion of the new 16-in



The 5000 barrel-per-day Tripoli refinery, the capacity of which will be doubled by work now in progress. Some of the thirty-six 93,000-barrel tanks are in the background.

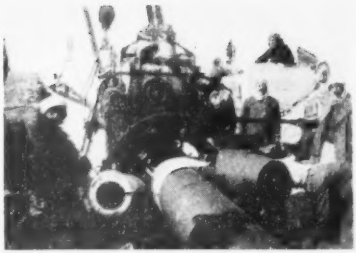
northern pipeline, an additional loading line and extra tankage have had to be installed at Tripoli.

Along both northern and southern pipelines a series of pumping stations not only supply the power necessary to sustain the flow of oil at the designed throughput and act as control points for checking the quantities passing through the line, but provide bases for line repair and maintenance. In addition to housing, each station has a service unit to accommodate offices and stores and to act as a defence post in the event of disturbance. Included in the service units are laundry, bakery, food store, dispensary, sickrooms, and wireless equipment.

Plans for increasing the capacity of the pipeline system were delayed by war, and it was not until October 1946 that construction began of the new 16-in lines paralleling the original 12-in lines.

Work commenced on the southern Kirkuk–Haifa line, which was completed to within 50 miles of the Haifa terminal by the spring of 1948, when disturbed conditions in Palestine suspended operations. Labour and materials were then transferred to the northern line. The section of 16-in pipe already laid for the southern line between Kirkuk and the Euphrates was used instead for the northern line, and all facilities were concentrated on the remaining 383-mile stretch

Completing the last weld on the 16-inch line from Haditha to Tripoli.



Wrapping the 16-inch line with fibre-glass and bitumen-impregnated asbestos felt.

to Tripoli. The total tonnage of 16-in pipe laid in this sector was 60,000, involving 6,287,000 ton-miles of transportation. In the lava and limestone country of western Syria and the Lebanon, blasting was necessary for an aggregate distance of some 50 miles.

When it is possible to complete the remaining 40 miles of the 16-in Kirkuk–Haifa pipeline, and to operate the 12-in pipe which has been shut down since July 1948, the combined capacity of the Kirkuk–Mediterranean system will be 270,000 b.d.

To provide for this throughput, the pumping stations west of the Euphrates are being enlarged and each is being re-equipped with six motor-driven Mather and Platt centrifugal pumps. On the section where northern and southern lines run parallel, the pump stations are each being equipped with four Worthington-Simpson horizontal reciprocating pumps. In addition, extra housing accommodation for staff, and schools for their children, are being built at each station.

Fuel Injection Equipment.—A booklet on the operation and maintenance of fuel injection for diesel engines of all types is available from Bryce Fuel Injection Ltd., Ironbarks Works, Staines, Middlesex.

COUNCIL COMMENTARY

TWENTY-THREE members of Council assembled at Manson House on September 14 under the chairmanship of the President. He informed us before proceeding to formal business of the sad news of the death of A. T. Beazley, paying tribute to his services, and requesting members to stand in silence.

Afterwards, the minutes of the July meeting were confirmed and signed, several matters arising being dealt with as follows:

The problem of certain members who are still in arrears with their subscriptions, but of whom it is hard to believe that they would wish to sever their connexion with the Institute, is still with us, and certain personal approaches are to be made by Council members to see if this situation can be altered. Messrs Chilvers and Hyams reported that they had rechecked from previous minutes the wording of a rule concerning financial responsibility of the branches, thus settling the differences of opinion put forward by members of Council at the previous meeting.

New matter comprised reports from two special sub-committees, in addition to the Election, Engineering, and Publications committees. In addition several miscellaneous items totalling about twenty gave us a full afternoon.

Mr Hyams, dealing further with the financial situation, drew attention to the foreseeable rise in the total payment as capitation fees to branches, and asked Council to reconsider the present rules governing such payment. A discussion followed, in which both sides of the question were well and truly brought out, i.e., on the one hand the argument that any particular capitation fee, which represents a recruitment through the branch, should be a net gain to the Institute by reason of the balance of members' subscription which was not paid as capitation fee, and on the other hand the fact that any increment in disbursement, for any reason, whatsoever, had to be regarded on principle with grave disfavour by the Chairman of the Finance Committee. It was finally decided to refer the whole question to the committee in October, Mr Hyams being invited to attend.

Great satisfaction was expressed with the recommendation of an *ad hoc* committee, that the next President should be C. A. P. Southwell, a recommendation which was unanimously approved.

In accordance with by-laws, Council decided that there should be six vice-presidents during 1950–51, and by drawing lots decided the vice-presidents not eligible for re-election, as E. B. Evans and H. Hyams.

The same procedure of drawing lots was adopted to decide that F. Morton, H. de Wilde, H. E. F. Pracy, G. H. Smith, G. H. Thornley, A. T. Wilford, and W. J. Wilson, are to retire, but are eligible for re-election. This lot-drawing business seems to be inescapable for some considerable time, and is a result of a period when the Council was not a full Council. This resulted in the by-law intention of retiring seven out of the twenty-one members each year, to give an average straight-run Council life of three years, being completely thrown out of balance by reason of a larger number than seven being elected during the first year in which it was decided to bring Council to full strength, and thus creating a situation where more than the seven members had equal seniority of service, and had to be reduced to seven by lot. It is expected, but without very great confidence, that in due course, this will sort itself out. There is no sign of this happening yet, and until it does, some get an extra long run and others have to "go to the country" after very short periods of service.

Another special sub-committee report was presented by Dr E. B. Evans, dealing

with the proposed selling price of "Standard Methods", "Petroleum Technology in 1946", and the Journal, the proposals being accepted by Council as follows:

Standard Methods:	
Full subscription	31*s.*
For members	26*s.*
Petroleum Technology 1946:	
Full subscription	27*s.* 6*d.*
For members	22*s.* 6*d.*
Journal (in view of increase of Corporate Members' subscriptions).	
Per copy	10*s.*
Annual subscription	£4 14*s.* 6*d.*

G. H. Thornley presented the Election Committee report, which was approved, and it is satisfactory to record that it dealt with thirty-seven new applicants for membership, and seven applicants for transfer to another category.

A report from the Engineering Committee was presented by R. B. Southall, and was approved, Council taking the opportunity of expressing appreciation of the excellent work being done by E. J. Sturgess and his Committee during its comparatively short life.

The London Branch announced through A. G. Goodfellow that they were considering the holding of a Dinner-Dance in December, and would welcome the support of members of the parent body. This was approved in principle, and it was arranged that the proposal should be examined further by Public Relations Committee in conjunction with the Committee of the London Branch.

Notification was given by Dr E. B. Evans on behalf of the Publications Committee that it was proposed to have a social evening either early in December 1949, or in January 1950, at which films would be shown and light refreshments be provided, this to take place in Manson House, at a cost of 5*s* per head. The suggestion was welcomed.

Public Relations Committee were authorized by Council to make arrangements for the holding of the Annual Dinner about the end of February, along the lines of the very successful function held this year.

The General Secretary read letters which had been sent by the President. One to Professor F. Morton congratulated him on being appointed to a chair in the University of Birmingham. The other to Council suggested that we should send a message of congratulation and appreciation to Cecil W. Wood, for long a member of Council, on the Jubilee number of the *Petroleum Times*, which suggestion was approved.

It was agreed that the Institute should accept the invitation to become a collaborating institution in connexion with the general discussion on heat transmission and apparatus. Also that the Liquid Fuels Panel should be asked to appoint a representative to the Advisory Committee of the National Smoke Abatement Society Exhibition.

Approval was given to the nomination by the Imperial College of Science and Technology of Bryan Lloyd Jones for the award of the Institute of Petroleum Scholarship.

A letter was read from the B.S.I., agreeing that B. J. Ellis should represent the Institute on their Petroleum Equipment Industry Standards Committee, but expressing regret that they were unable, in accordance with their by-laws, to allow the Institute of Petroleum to be represented on their General Committee.

In conclusion T. Dewhurst referred to the President's forthcoming visit to America on the invitation of the A.P.I., A.S.T.M., and S.A.E., and expressed on behalf of Council their best wishes for a successful and enjoyable visit. In thanking Mr Dewhurst and the Council for their good wishes, Mr Evans stressed that he had been invited as President of the Institute of Petroleum.

STANLOW BRANCH AT BOWATER'S PAPER MILLS

A party of some thirty members of the Stanlow Branch paid a visit to Bowater's Paper Mills at Ellesmere Port on the evening of September 7.

These mills produce a large proportion of the newsprint manufactured in Britain, and their primary function is to supply the requirements of those editions of the national newspapers which are printed in Manchester.

The mills are situated on the banks of the Manchester Ship Canal and, starting with the unloading of wood-pulp imported from Newfoundland, the party were able to follow the process of newsprint manufacture.

The works has its own power plant, producing steam in coal-fired tubular boilers and generating electricity sufficient for the requirements of a small town.

Wood-pulp and chemical pulp, together with a proportion of waste paper and china clay, are repulped in hot water to a consistency of thick porridge, and this is distributed on to an endless belt of fine mesh gauze travelling at high speed, which allows the bulk of the water to pass through, leaving an even layer of soft pulp. The leading edge of this layer is carried forward by an ingenious arrangement of jets of compressed air to the first of a long series of rolling mills. The rolls are heated by steam, and as the paper moves forward it is pressed and dried. There are two series of rolling mills set side by side and extending over a distance of some 300 yards.

The mills are driven by electric motors and the drive to each press is synchronized to compensate for the initial expansion and subsequent contraction of the paper as it is pressed and dried.

The paper emerging from the mills is wound in huge rolls and is transferred to calendering machines which give the requisite polish and finish to the paper. The finished rolls of paper are finally transferred to a machine in which they are cut to the required lengths by revolving disc-shaped knives.

The finished rolls are packed in stout paper and sent to the loading shed for dispatch by road and rail.

The whole operation is carried out at high speed and with a high degree of quiet efficiency which tends to make the onlooker forgetful of the engineering skill and organization required to maintain the mills in smooth operation.

At the conclusion of the visit, C. D. Brewer expressed the thanks of the branch to Messrs Bowater's and to the guides who made the visit so instructive and interesting.

REPORT ON FILLING STATIONS

Recommendations that there should be three grades of petrol filling stations, with minimum standards defined for each, have been made by the Petrol Stations Technical Committee in its report* to the Minister of Transport. The committee was set up in 1947 to report on the technical considerations which should govern the number, capacity, and distribution of petrol stations in urban and rural areas; the minimum standard of service which these stations should provide; and whether stations should be divided into classes corresponding with defined standards of service.

The report makes the following recommendations:

A Grade I station should have, as minimum requirements, four power-operated pumps with a total of 6000 gallons storage capacity, stocks of oil, water supply, driveway and forecourt with hard surface, frontage of 150 feet, air compressor for tyre inflation, toilet accommodation, and a twelve-hour adequate service, seven days a week. Recommended requirements are stocks of plugs, fuses, and bulbs.

* H.M.S.O., 1949, 3*s* 6*d*.

Minimum requirements for a Grade II station would be two power-operated pumps, storage capacity of 3000 gallons, stocks of oil, water supply, driveway and forecourt with hard surface, toilet accommodation, and adequate six-days-a-week service.

For a Grade III, recommended minimum is one pump with 1500 gallon storage capacity, stocks of oil, water supply, and adequate service during normal business hours.

It is suggested that on motorway, trunk road, and Class I roads in rural areas, new stations should, with a few minor exceptions, all be Grade I. In urban areas new stations on important traffic routes should be Grade I. New stations should be planned so as to avoid vehicles being refuelled on the highway.

On the question of frequency of stations, a possible guide to local authorities when considering applications to open new stations is given by the following:

No. of vehicles likely to need petrol facilities (16-hr census)*	*Stations per mile*	*Miles per station*	*Miles per station on each side of road*
Over 2000 daily	0·4	2·5	5·0
Over 1000 but less then 2000 . .	0·33	3·0	6·0
Up to 1000	0·2	5·0	10·0

CONTROL

It is recommended that inspection of petrol stations should come under the Home Office and that county councils and county borough councils should be the licensing authority, the Petroleum (Consolidation) Act, 1928, being amended for the latter purpose.

SURVEY OF FACILITIES

In compiling the report, two surveys were carried out. The first, made during the summer of 1947, took a representative selection of roads of all classes in rural areas. It covered in all 558 miles of trunk roads with 335 stations and 1453 pumps; 529 miles of Class I roads with 242 stations and 810 pumps, and 420 miles of Class II roads with 101 stations and 265 pumps. The second survey, dealing mainly with urban areas, included data on petrol station facilities in two large cities, Bristol and Birmingham, 14 smaller towns, and the whole of the county of Somerset. Full details of these surveys are given in tabular form as appendices to the report.

Among the statistics compiled by the committee are figures of the number of selling points of petrol in the U.K. in 1946 as compared with the pre-war total. "Selling points" include not only garages and filling stations, but hotels and similar establishments which keep a petrol pump for the convenience of the guests.

RETAIL SELLING POINTS

	No. of Selling Points with pumps		*No. of pumps in use*		*Throughput (gal) per pump*	
	1938	1946	1938	1946	1938	1946
England and Wales	30,300	25,400	86,800	61,700	8,600	10,500
Scotland	3,700	3,200	9,200	6,200	8,000	9,600
North Ireland	1,200	1,000	2,100	1,500	7,000	10,400
Total U.K.	35,200	29,600	98,100	69,400	8,500	10,400

* Includes motor-cycles, cars, vans, light lorries, and 25 per cent of the heavy goods vehicles.

INJURY RATES IN THE U.S. OIL AND GAS INDUSTRY

In a report recently issued by the U.S. Bureau of Mines* it is shown that, although the frequency rate† of 15·08 for injuries in the U.S. oil and gas industry during 1947 was slightly higher than the 1946 figure of 14·88, the severity rate was an improvement.

The statistics in the report are based on returns from 1125 companies in 1947, compared with 1040 in 1946. It is estimated that the greater part of the industry is covered.

In the report the figures are given in considerable detail and extracts are given in Tables I and II.

TABLE I

INJURY AND EMPLOYMENT DATA
U.S. OIL AND GAS INDUSTRY

	1945	1946	1947
Number employed	384,139	430,444	453,173
Man hours	899,223,917	917,330,921	963,429,013
Number of injuries:			
Fatal	144	169	149
Non-fatal	14,066	13,482	14,375
Days of disability:			
Fatal	864,000	1,014,000	894,000
Non-fatal	516,036	506,732	533,133
Injury-frequency rates:†			
Fatal	0·16	0·18	0·15
Non-fatal	15·64	14·70	14·92
Injury-severity rates:‡			
Fatal	0·96	1·11	0·93
Non-fatal	0·57	0·55	0·55

TABLE II

INJURY DATA BY DEPARTMENTS
U.S. OIL AND GAS INDUSTRY, 1947

Department	*Men*	*Man-hours*	*Injuries* *Fatal*	*Non-fatal*
Exploration	9,309	20,403,598	1	400
Drilling	14,133	28,322,755	18	1,836
Production	69,003	143,756,374	34	2,833
Natural gasoline	10,299	20,991,400	1	282
Pipelines:				
Oil	29,405	61,536,040	5	832
Gas	10,975	22,913,702	5	435
Transport:				
Ocean and coastwise	7,704	22,285,856	5	518
Inland waters	2,330	6,463,517	2	102
Refining	141,884	296,721,436	40	2,894
Marketing	121,944	265,179,574	23	3,272
Miscellaneous	29,550	60,829,304	12	735
Not classified	6,637	14,025,457	3	236
Total 1947	453,173	963,429,013	149	14,375

* H.S.S. No. 386, prepared by J. H. Schuster and G. W. Crone, under the supervision of F. T. Moyer, chief of Accident Analysis Branch, Economics and Statistics Division.

† No. of disabling injuries per million man-hours.

‡ Days of disability per 1000 man-hours exposure.

BEILBY MEMORIAL AWARDS

The administrators of the Beilby Memorial Fund announce that they will be glad to have their attention drawn to outstanding work carried out by British investigators in science for consideration for their 1950 awards. Preference will be given to investigations connected with fuel economy, chemical engineering, and metallurgy. In recent years the amount of each award has commonly been 100 guineas.

Communications should be sent, not later than December 31, 1949, to the Convenor, Administrators of the Sir George Beilby Memorial Fund, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

A. MILVERTON RETIRES

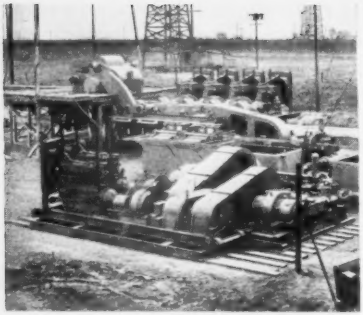
After fifty years' service with the Anglo-American Oil Company, Mr A. Milverton, for many years the firm's chief cashier, retired last July. He joined the company at the age of fifteen in 1899 and was posted to the cashier's department after his army service during the 1914–18 war. A radio-gramophone and a wallet were parting gifts from his old colleagues, while earlier in the year the company presented him with a long-service star and fifty guineas' worth of savings certificates.

(Left to right) *R. A. Carder (chairman, Anglo-American Oil Co.), A. Milverton, W. E. Jenkins (director), A. Waterston (director).*

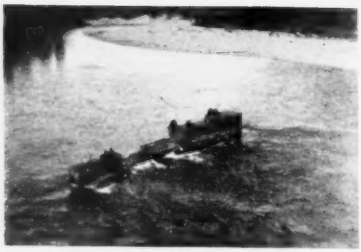
LONDON BRANCH AT ABINGDON

Photos by N. E. F. Hitchcock

In our issue of August we reported the visit of the London Branch to Abingdon. How successful and enjoyable that outing was is illustrated above. In (1) we see how large was the attendance, while the next five pictures indicate the varied nature of the entertainment. In (7) the secretary of the Branch takes a brief respite from his efforts, while in (8) the coach fills up with contented passengers for the homeward journey.



1941—In the works.



1942—Crossing the Teremakau River, New Zealand.

A GLOBE-TROTTING RIG

A travel log of 25,000 miles is claimed for a large drilling rig, built by the National Supply Company in California in 1941, which is now being put to work in Alaska. The rig was first used at Mendota, California, early in 1942. May of the same year found it *en route* to New Zealand, where it had to be conveyed through mountain passes and forded across flooded rivers before reaching its destination at Lyttleton, South Island. After several dry holes had been drilled the project was abandoned, and the drill was sent all the way back to Los Angeles. In 1945, the U.S. Navy acquired the rig, which was pronounced in good shape despite its foreign service and long travels. It drilled several wells in the Elk Hills Naval Reserve area, before being reconditioned prior to its trip to Alaska.

1942—Drilling in New Zealand.

WORLD POWER CONFERENCE

Among the papers to be presented by the British National Committee at the fourth World Power Conference (to be held in London from July 10 to 15, 1950) are: "Recent developments in petroleum processing", by P. Fleming and Dr T. Tait (*Anglo-Iranian Oil Co. Ltd.*); "The use of heavier distillates from petroleum for the production of power", by Dr C. G. Williams and A. Wilson (*The Shell Petroleum Co. Ltd.*); "Fuels for high-speed diesel engines", by C. S. Windebank, L. D. Derry, and E. B. Evans (*Esso Development Co. Ltd.*); and "Oil-fired marine boilers", by Captain (E.) W. Gregson, R.N.R. (*Babcock and Wilcox Ltd.*).

Ultra-violet Radiation Equipment is the subject of a folder available from Hanovia Ltd., Slough, Bucks. This contains particulars of laboratory lamps and sources of ultra-violet rays for air, sanitation, etc.

WHAT IS "MOTOR SPIRIT"?

Subtle distinctions in the legal definition of "motor spirit" were recently considered by the High Court of Justiciary (Scotland) in the case of *Winning* v. *Adair* (1949 S.L.T. 212). The appellant had been convicted of an offence under the Motor Spirit (Regulation) Act, 1948, in that he had commercial petrol in the tank of a private car. By the Motor Spirit Regulations, 1948, made under the Act, commercial petrol is defined as motor spirit to which diphenylamine has been added. In the present case the analyst's certificate showed that diphenylamine was present, and this finding was not disputed. However, the analyst's certificate also stated that "the sample was motor spirit as defined by S.R. & O. 1944, No. 281, section 74". This defines motor spirit by prescribing the distillation limits (not less than 50 per cent distilling at not more than 185° C or not less than 95 per cent at not more than 240° C) or the flash-point which, for the material to be motor spirit, has to be less than 22·8° C, the test procedure being as in "the Acts referring to petroleum".

However, this S.R. & O. was obsolete at the time of the offence which it was alleged the appellant had committed, and the definition of motor spirit laid down in the 1948 Regulations (S.I. 1127 of 1948), whilst substantially similar (and in fact identical from an analytical aspect), refers to the test methods laid down in the 1948 edition of the Institute of Petroleum's "Standard Methods" and, in particular, the flash-point limit is given in the 1948 Order as 73° F.

When the case was before the Sheriff, the latter compared the definitions given in the 1944 and 1948 orders and the respective test methods prescribed therein. Having concluded that they were equivalent in that one of the criteria, namely, the flash-point, was similar in both, he convicted the appellant.

Whilst the Sheriff was undoubtedly correct in his interpretation of the two definitions from a petroleum technologist's viewpoint, it was held that he had erred in law. The question of whether the two definitions were identical and whether the methods laid down in the 1942 edition of "Standard Methods" (which, by implication from a preceding section of the 1944 order could, perhaps, be held to apply to section 74 of that order) were the same as those laid down in the 1948 edition, is not the simple one it appears and, in the words of the Lord Justice-Clerk, "the comparison of the two differing definitions was a scientific matter".

Hence, before deciding that they were the same the Sheriff should have heard scientific evidence on the point; in the absence of such evidence there was a gap in the case for the Crown, and the conviction could not stand.

The confusion between the various editions of "Standard Methods" seems even to have spread to the High Court, since at one point in his judgment Lord Mackay is reported as stating that the 1944 Order, referred to above, prescribed the 1944 edition of what he calls "this important standard book", whereas the 1944 Order in fact refers to the 1942 edition.

This case should be of interest to analysts as indicating the strict accuracy with which their certificates must be worded if they are to be used as evidence in support of a criminal charge; the court made it clear that whilst it only set the conviction aside with some reluctance, the rule that the facts put before the court in a criminal cause are to be strictly proven must be upheld.

V. B.

Petroleum Technology 1946.—Progress in all branches of the petroleum industry are summarized and over 3000 literature references are given. Published, October 1949, by the Institute of Petroleum. Price 27*s* 6*d*.

SHIPMENT OF BULK BITUMEN

Bitumen is to be shipped in bulk from Curaçao, N.W.I., to meet the demand expected to result from expansion of road construction activities and the revival of industrial building in Europe.

Denmark and Portugal are to be the first European countries to receive bulk bitumen, and construction has begun at Copenhagen, and at Setubal, south of Lisbon, of 6000-ton storage depots.

For the transatlantic shipment of "hot" bitumen, Shell has converted three 9000 d.w.t. tankers, the *Lembulus*, the *Labiosa*, and the *Liparus*, at a cost of £30,000 each. The centre tanks, with a capacity of about 4500 tons, have been equipped with heating coils and fitted with jacketed lines and pumps. The balance of the cargo in the wing tanks of the vessels is to consist of black oils. Previously in Europe bulk shipment has been confined almost entirely to coastwise haulage of locally manufactured bitumen by small 2000- to 2500-ton tankers.

The 9110-d.w.t. M.S. "Labiosa," launched in 1948, to carry bitumen. The eight centre tanks have been fitted with heating coils to maintain the bitumen at pumping temperature.

NEW 28,000-TON TANKER

World Liberty, a new 28,000-ton tanker with a liquid cargo capacity of 10,000,000 gallons and an overall length of 624 ft 7½ in, was recently launched at the Quincy (Mass.) Yard of the Bethlehem Steel Co.'s Shipbuilding Division. Owners are World Tankers, Inc., and the ship is to go on long-term charter to the Asiatic Petroleum Corporation.

The tanker's liquid-cargo space, 370 ft long, is divided into thirty separate tanks. Forward are two large dry cargo spaces, a ballast tank, and another large tank for either ballast or reserve fuel.

Propelling machinery consists of a set of steam turbines designed to deliver 13,760 shaft h.p. when driving the 22-in diameter propeller at 103 r.p.m. through Falk reduction gears. Two Foster-Wheeler water tube boilers will generate steam at a pressure of 600 p.s.i. and a temperature of 850° F.

HEAVY FUELS IN DIESEL ENGINES

The system involved in the Anglo-Saxon Petroleum Co.'s experiments in burning heavy fuels in diesel engines was protected by patents before the details were published in the *Transactions of the Institute of Marine Engineers* in February 1948. While the company do not desire to restrain the adaptation of ships or to impose any onerous conditions, they feel that those desiring to use the system would wish by inquiry at the outset to obtain any necessary permission to proceed.

Oil Purification.—Sharpies Centrifuges Ltd., of "Tower House", Woodchester, Stroud, Glos., have issued a copiously illustrated booklet on the working method of the Sharples Super-Centrifuge. Tables of specifications and data are included.

PETROLEUM FRACTIONS

By F. W. STOYLE

THE members of the British Printing Ink Association have been investigating for some time the uses of petroleum oil fractions in the manufacture of printing inks. At present the supply of these fractions is confined to the U.S.A., where a wide variety of short-range distillates are produced by the oil companies. The availability of these fractions enables inks to be produced which are especially suited to the newest developments in modern printing machinery, particularly in the case of machines operating at high speed. In view of the current difficulties with dollar materials and the need to expand existing, and develop new markets, it is of the greatest importance for the printing ink industry that supplies of the fractions should be available from production in the United Kingdom.

At present, however, member firms have reached the full-scale experimental stage in the use of these fractions. It is, therefore, most desirable to have available reasonable amounts of a number of fractions in order to establish the most suitable boiling range. Eventually it is hoped to be able to select a suitable range for the inks required for the varying machine speeds in the printing industry. It is clear, however, that the total demand for the fractions by the printing ink industry in Britain is never likely to be large, although the industry would be capable of paying an adequate price.

For some considerable time efforts have been made to interest distillers to produce a range of petroleum fractions, but so far only small samples have been prepared for experimental purposes. These have only served to show how useful larger supplies would be. It is desired to know, therefore, whether any other industries are in need of, or could use such fractions, so that their requirements could be added to those of the printing ink industry. In this way it might be possible to establish a demand economically worth satisfying.

A provisional specification of the fractions which has so far been developed by the Association is as follows:

The material shall be essentially petroleum products:

(*a*) *clear, mobile liquids, free from water, visible impurities, and at 70° F free from objectionable odour;*

(*b*) *in the apparatus specified in I.P. Test 28/42, the range of individual cuts should be as close to 10° C as possible within the limits 200° C to 300° C;*

(*c*) *any fraction more volatile than the bulk should not exceed 10 per cent;*

(*d*) *aromatics should not exceed 15 per cent maximum; Kauri Butanol not more than 20 to 30 per cent;*

(*e*) *corrosive sulphur should be absent and evaporation rate uniform for 5 to 95 per cent.*

Interested parties are invited to communicate with the author at the British Printing Ink Association, 79/80 High Holborn, London, W.C.1.

The Governor-General of Mozambique, Capt. Gabriel Mauricio Teixeira (left) *examining the magnetometer head used in the aerial mapping of 47,000 square miles for the Mozambique Gulf Oil Corporation. With him are J. C. Higgblom, manager of the company's exploration programme, and E. F. Peterson of the Aero Service Corporation.*

SYMPOSIUM ON INDUSTRIAL GEAR LUBRICANTS

This symposium, with three technical papers, was arranged by A.S.T.M. Committee D-2 on Petroleum Products and Lubricants to provide experiences and data on the properties of industrial gear lubricants.

E. M. Kipp, I. S. Kolarik, and C. A. Zeiler, of the Aluminum Company of America, describe tests using the Falex, Timken, and Four-ball machines for the evaluation of heavy duty gear oils. Each oil is evaluated in the three machines, and the data combined by means of standard rating charts.

John F. Pelly, of the Bethlehem Steel Corp., gives data on steel plant gear lubricants, and suggests a list of gear oils with specific viscosity to meet all steel plant needs.

A unique application of the cathode ray oscilloscope in tracking down difficulties is described by A. R. Purdy and J. H. Goffe, of the Socony-Vacuum Oil Co. The authors describe various applications and show that periodic checking of critical locations in a gear set may overcome serious problems.

Copies of this 24-page publication, with heavy paper cover, can be obtained from A.S.T.M. headquarters, 1916 Race Street, Philadelphia 3, Pa., U.S.A., at 75 cents each.

Man as a Maker of Landscape is the title of the 1948–9 Abbot Memorial Lecture, the text of which is published by the University, Nottingham, at 1*s* 6*d*. In it the lecturer, Dr H. H. Swinnerton, Curator of Nottingham University Museum, describes the geological work done directly by man, who, in mining, quarrying, and sinking deep wells, brings about striking changes in local topography.

STANDARD SAMPLES OF HYDROCARBONS

A total of 169 compounds are at present available as U.S. National Bureau of Standards standard samples of hydrocarbons. Two mimeographed lists recently issued by the N.B.S. give, in one case, details of all the 169 compounds now available, including sample number, formula, name, amount of impurity, vol per unit, and price per unit. In the other list details are given of only the seven newest compounds, which became available on June 30 last.

These lists are supplementary to the N.B.S. publication "Standard Samples Issued or in Preparation by the National Bureau of Standards" (issued January 1, 1949).

CANADA–U.S. PIPELINE

Plans are being made by the Interprovincial Pipe Line Co., an affiliate of Imperial Oil Co. Ltd. of Canada, to raise $90 million for the construction of a 1150-mile pipeline from Edmonton, Alberta, to Superior, Wisconsin.

Prepared by Aero Service Corporation for Creole Petroleum Corporation, this plastic relief map of Venezuela measures 45 by 56 inches, but weighs only 2 lb. It replaces the heavy, fragile plaster maps previously used in schools, etc.

A WILD CAT

By A. F. DABELL (Fellow)

It was in the days of the Czar that a wild-cat well, being drilled on the slopes of the Caucasus, blew in without the slightest warning sign, fully justifying this name and its cumulative enrichment by the staff.

A road had been cut to an elevated site and the remaining tree-boles stamped by the forest warden to indicate that the girth of each had been duly measured and recorded for payment after the State schedule. On the part of the oilfield staff, there was pious pride in the fact that they had not employed the cheaper method of borrowing the warden's die for such stamping whilst entertaining him to the point of saturation.

In the clearing had been built the 60-foot timber derrick of "portable" type, in that bolts and nuts replaced nails, and some storage space had been excavated and embanked. (So many passive wild cats had been drilled.)

Drilling was by the percussion system, using wire rope and a walking-beam. Sand and gravel carried by the initial eruption quickly cut away the nose of the beam and, after juggling with the intervening temper-screw, severed the cable attached to the tools in the well.

The end of this rope could then be seen whirling around in the liquid, above the head of the well casing, like an enraged cobra.

It was noted, however, that the rope was shortening and the derrick head bristling with pieces of wire some $\frac{1}{8}$-inch in diameter and 2 inches in length, partly embedded in the timber, porcupine fashion.

Even when the rope end vanished from sight the whirl-like form of the discharging liquid indicated that disintegration of the rope continued. (Only some 18 inches of rope was found attached to the drilling tools when recovered a year later.)

Meanwhile the "storage accommodation" filled and some 7000 barrels per day began coursing down the hill-side heading for a larger dry valley below in which, it was obvious, a dam should be constructed. But where?

Siting was dependent upon favourable surface condition, the time lost in recruitment of peasant diggers from scattered villages, the depth of alluvial to be excavated before building the dam proper (four rammers for each shoveller) etc., all before the van of the flow arrived.

It arrived carrying leaves, twigs, and moss when the dam bank was but 10 inches higher. This was maintained, for by this time some assistance was afforded by one pump installed. (The debris caused pump trouble which was alleviated by an ingenious member of the staff wrapping around the pump suction a flexible wire bed mattress, borrowed from the bungalow of a colleague—in his absence.)

An increase of casual labour then permitted the commencement of a second (lower) dam and the installation of a battery of pumps.

Back at the well it was appreciated that gravel striking steel at the derrick head would yield sparks, but for the flooded state of the points of contact. But it was also appreciated that wells blowing wide open and yielding sand have a habit of surging, at times to the stage of momentary cessation of flow, due to bottom hole caving bridging the casing. If this occurred the safety element—flooding—would be momentarily absent, and should sparking follow, a sheet of flame would rush through the gas entrapped by the surrounding forest, killing all therein and leaving raging fire on the oil-soaked terrain.

The removal of the derrick was obviously called for, both as a measure of fire precaution and to de-gas the forest by allowing unobstructed release of the oil and gas to above the tree-tops.

But would the arc described by the derrick-head in falling create the critical conditions feared?

The risk was accepted.

Two carpenters went in and, with a crosscut saw with water playing upon it, removed some two feet from one leg—but the derrick stood.

The operation was repeated upon another leg. The derrick still stood. That it was possible for these men to work under a shower of oil is due to the upward rush of liquid at high velocity creating induced draught in the vicinity of the well mouth. That they willingly did so was not due to ignorance, nor lack of imagination, but to the fact that the true Russian is careless of death.

A rope was attached to the intact side, and with the aid of a Spanish windlass brought the derrick down, with no ill effect. The column of oil soared 500 feet into open sky.

I did not see the fall, as in deadly fear I had my face pressed into the soft belly of my riding horse. (I had seen men die twelve hours after inhalation of almost invisible flame flash.)

Controlling the Giant

Now to bring the well under control. For this, a tubular cross was constructed with its lower member in the form of an inverted funnel lined with lead, its horizontals carrying 6-inch valves, and the whole surmounted by an 8-inch valve—the diameter of the well casing.

When finished, it was carried by ropeway over the well mouth where, after some cavorting, the column of liquid passing through held it rigidly vertical in central position after the manner of jet-supported balls in shooting booths.

Workmen then secured it to foundation timbers by stretching screws; the upper valve was closed gradually and the oil (by this time carrying no sand) given release through the side branches and piped direct to the reservoir.

The "cat" was harnessed, but her harness would not have withstood closed-in pressure. Moreover, wells flowing from sand have been killed by entire closure.

The terrain was purified by diggers, a prayer for rain was met with due response to the end that no trace of oil or gas was in evidence at or around the well, and an exhausted staff (with which a continent could have been colonized) were able to discontinue sleeping with grated raw potato bound over their eyes—the remedy for oil-gas inflammation—and proceed with the cleaning of all with which they had come in contact in their homes. Saddles were never thereafter to be relied upon.

Fire!

It was not long before light in the night sky showed that at last there was actual fire to deal with, and the storage valley was discovered to be a mass of flame.

The discharge lines were led into another valley which in anticipation had already been dammed, and the fire allowed to burn to extinction. Then, upon one side of the valley, was revealed the fire's origin in the swollen scorched corpse of a watchman with pieces of flint, steel, and a metal tobacco box beside it—and our negligence in the prohibition of the carriage of only matches within the prescribed area.

As the pumping installation had been more fully developed in this valley, when it had cooled and watered the delivery was returned to it.

At midnight the valley was again in flame, and the process of deflection and return repeated, but in this case the origin could not be discovered.

After a third fire an observant watchman reported that an old tree-stump in

the enclosure appeared red at night-time. Upon cutting into it glowing tinder was found in the centre—presumably a legacy from the first fire. Its removal completed technical operations.

Back at the office, in the meantime, notice had been served for, *inter alia*:

1. *Compensation for damage done by oil falling upon plants in a tobacco plantation owned by Greeks some half-mile distant.*
2. *Liability for damage to State forest.*
3. *Compensation for fish poisoned in the Black Sea over 100 miles distant.*

And a *caveat* by the owner of contiguous mining rights.

1. With the Greeks we temporized by agreement to pay the deficit shown between their eventual crop value and that of the best year preceding, based upon Excise declarations.

2. In the matter of the trees an official from the State Forest Department ruled that assessment would be deferred until the spring, when lack of foliage would define injury.

3. The fishermen were asked for proof to support their claim.

Eventually:

1. As no claim was ever presented by the Greeks it is to be assumed that the (young) plants were sprayed both timely and efficiently. (That spray must have been of fungicidal nature.)

2. In the spring, a young forest official registered claim for but a few hundred charred trees. (Presumably non-vaporized sap was responsible for the growth of foliage in the remainder, for in the spring following, and for ever thereafter, several thousand lacked proof of life.

3. Neither the fishermen nor the potential litigant pursued their claim.

Incidentally, our chemist, who at the outset had collected a sample of oil running from a nearby roof, reported, after analysis, that its nature differed from that of the crude of the district. He failed to appreciate that the composition of light crude leaving the well mouth would vary somewhat from that which had journeyed through the open air and fallen on the roof.

"London" expressed the desire for more optimism when planning future "exploratory" wells.

Speculators who cabled their London friends to buy shares in this company probably added to staff nomenclature upon learning later that these shares were not fully paid up.

Neither "London" nor shareholders dreamed of that which they escaped—had she surged before the derrick was thrown.

The rated compensation payable to bereaved dependants was heavy. The Russian peasant is prolific.

———

METRIC OIL MEASUREMENT TABLES

CORRECTIONS

It is regretted that two errors occurred in the report on the Brussels Conference in our August issue. On page 252, para. 3, the figure for the density of air should be 0·00122 g/ml and not 0·001222 as stated.

In para. 6 on the same page the formula should read:

$$D = \frac{\text{Mass of any given volume of oil at } 15^\circ\text{C}}{\text{Mass of equal volume of water at } 4^\circ\text{C}}$$

Note

The above formula was agreed in Brussels in view of the various Continental interpretations of the English word *Density*.

Since the Brussels Conference, the delegates who were from countries using the metric system have been asked to obtain from their standardizing bodies an official verdict as to whether the above definition is preferred to the usual

$$D = \text{Mass per unit volume.}$$

However, since the result will be the same whether tables entered with D are entered with mass per unit volume or with specific gravity $15^\circ\text{C}/4^\circ\text{C}$, the question appears to be of academic interest only.

FORTHCOMING MEETINGS

INSTITUTE MEETINGS

Oil Prospects in the Netherlands.—W. J. Mulders. At 26 Portland Place, London, W.1., 5.30 p.m. (*tea 5 p.m.*), December 14.

The Testing of Liquefied Gases and Light Distillates, of Lubricants, and of Bitumen, and the Measurement and Sampling of Petroleum.—Members of the Standardization Committee. At 26 Portland Place, London, W.1., 5.30 p.m. (*tea 5 p.m.*), January 11.

NORTHERN BRANCH

Annual General Meeting. Address by Col. S. J. M. Auld, O.B.E., M.C.—At Engineers' Club, Albert Square, Manchester, 6.30 p.m., January 17.

SOUTH WALES BRANCH

Bitumen Horizons.—A. W. Jarman. At Britannic House, Llandarcy, 5.30 p.m., December 1.

STANLOW BRANCH

Operational Research in Industry.—R. E. Strong. At Grosvenor Hotel, Chester, 7.15 p.m., December 15.

Motor Racing.—E. A. Evans. At Grosvenor Hotel, Chester, 7.15 p.m., January 18.

MEETINGS OF OTHER SOCIETIES

Current Trends in Refining.—F. Morton. Institute of Fuel, Midland Section. At James Watt Institute, Birmingham, 2.30 p.m., December 7.

The Mass Spectrometer.—V. W. Rowlands. Royal Institute of Chemistry. At Widnes Municipal Technical College, 7 p.m., December 8.

The Composition of Fractionating Column Products Under Various Reflux Conditions.—J. S. Forsyth and N. L. Franklin Institution of Chemical Engineers, N.W. Branch. At College of Technology, Manchester, 3 p.m., December 10.

Fluid Flow Through Granular Beds.—J. M. Coulson. Institution of Chemical Engineers. At Geological Society, Burlington House, London, 5.30 p.m., December 13.

Development of the Doxford Oil Engine during the Last Decade. W. H. Purdie. N.E. Coast Institution of Engineers and Shipbuilders. At Mining Institute, Newcastle-upon-Tyne, 6.15 p.m., January 13.

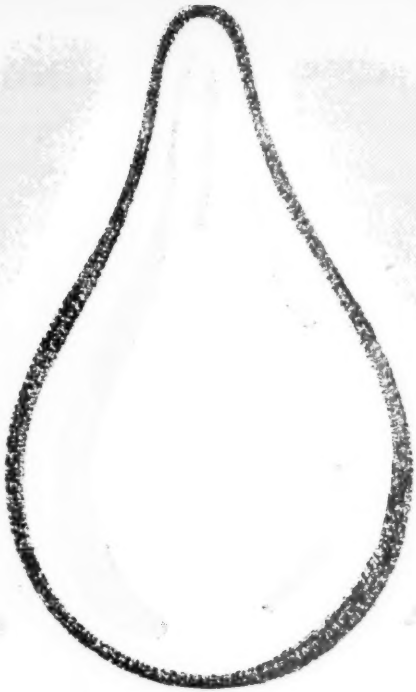
WORLD PETROLEUM STATISTICS

A new publication by the U.S. Bureau of Mines is *World Petroleum Statistics*, the first issue being for the months of January and February 1949. It consists of two tables for each month: (1) a balance of crude petroleum supply and demand, and (2) production of major refined products, both by countries. The column headings and world totals for the two months are:

	January 1949	*February* 1949
	In 1000 barrels	
Crude oil supply and demand:		
Production	291,012	263 492
Imports	60,043	55,224
Exports	62,732	53,118
Crude run to stills	283,863	252,408
Other demand and losses	3,927	2,626
Stock change	533	10,564
Production of major refined products:		
Motor fuel	101,266	90,521
Kerosine	16,630	14,603
Distillate fuel oil	46,121	40,881
Residual fuel oil	83,747	73,956
Lubricating oil	5,025	4,423
Total	252,789	224,384

New Italian Refinery.—Work is progressing on the site at Rho, near Milan, where Condor S.p.A. per l'Industrial Petrolifera e Chemica are to erect a one-million-ton per annum refinery. Planning and development has also started for a 100-mile 10-inch pipeline to transport crude oil from Genoa to the refinery.

Stanic, a new Italian refining company jointly owned by Standard Oil Co. (New Jersey) and the Italian-owned company Anic, is to modernize its Leghorn and Bari refineries. Initial capital of Stanic is to be increased from 20 million lire to 12 billion lire. Present combined capacity of the Bari and Leghorn plants is approximately 16,000 brl/day, using crude from Middle East sources.



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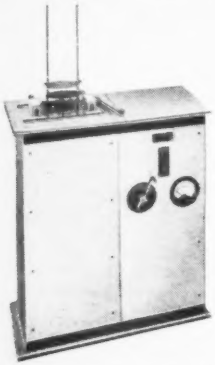

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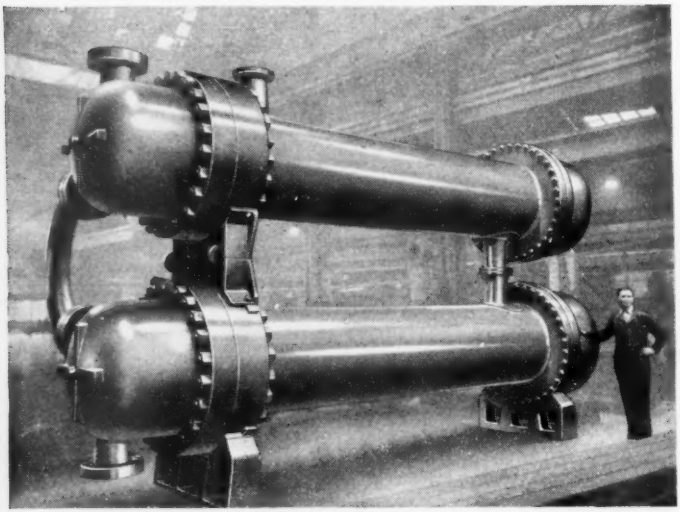

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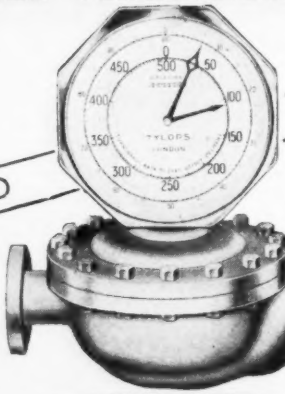

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